

What we claim is:

- 1 1. A method of restarting a permanent magnet turbogenerator/motor, comprising the
2 steps of:
 - 3 determining that the permanent magnet turbogenerator/motor has a fatal fault present and
4 is in the process of shutting down;
 - 5 determining that the permanent magnet turbogenerator/motor has more than a fixed
6 number of restart attempts since the permanent magnet turbogenerator/motor was determined to
7 have a fatal fault; and
 - 8 continue shutdown of the permanent magnet turbogenerator/motor.
- 2. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
grid connect mode and said step of determining that the permanent magnet turbogenerator/motor
has a fatal fault present and is in the process of shutting down comprises the steps of:
 - detecting an over-current condition;
 - determining that less than a fixed number of over-current events have occurred within a
fixed period of time;
 - disabling the output power converter of the permanent magnet turbogenerator/motor;
 - determining that the output current of the permanent magnet turbogenerator/motor is at a
normal level in all phases; and
 - enabling the output power converter of the permanent magnet turbogenerator/motor to
continue normal operation of the permanent magnet turbogenerator/motor.
- 1 3. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
2 grid connect mode and said step of determining that the permanent magnet turbogenerator/motor
3 has a fatal fault present and is in the process of shutting down comprises the steps of:

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4 detecting no output over-current;
5 detecting a loss of output current control or a loss of DC bus voltage control;
6 determining that more than a fixed number of warning faults has occurred within a fixed
7 period of time;
8 reporting a grid fatal fault and initiating shutdown of the permanent magnet
9 turbogenerator/motor.

1 4. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
2 grid connect mode and said step of determining that the permanent magnet turbogenerator/motor
3 has a fatal fault present and is in the process of shutting down comprises the steps of:

4 detecting no output over-current;
5 detecting a loss of output current control or a loss of DC bus voltage control;
6 determining that less than a fixed number of warning faults has occurred within a fixed
7 period of time;
8 reporting a grid unbalance warning fault;
9 disabling the output power converter of the permanent magnet turbogenerator/motor;
10 analyzing the grid voltage magnitude and frequency for an acceptable connection; and
11 enabling the output power converter of the permanent magnet turbogenerator/motor to
12 continue normal operation of the permanent magnet turbogenerator/motor.

1 5. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
2 grid connect mode and said step of determining that the permanent magnet turbogenerator/motor
3 has a fatal fault present and is in the process of shutting down comprises the steps of:

4 detecting no output over-current;
5 detecting a loss of output current control or a loss of DC bus voltage control;

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6 determining that less than a fixed number of warning faults has occurred within a fixed
7 period of time;
8 reporting a grid unbalance warning fault;
9 disabling the output power converter of the permanent magnet turbogenerator/motor;
10 analyzing the grid voltage magnitude and frequency for an unacceptable connection;
11 determining that the maximum allowable reconnection time has expired; and
12 reporting a grid fatal fault and initiating shutdown of the permanent magnet
13 turbogenerator/motor.

1 6. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
grid connect mode and said step of determining that the permanent magnet turbogenerator/motor
has a fatal fault present and is in the process of shutting down comprises the steps of:
detecting no output over-current;
detecting a loss of output current control or a loss of DC bus voltage control;
determining that less than a fixed number of warning faults has occurred within a fixed
period of time;
reporting a grid unbalance warning fault;
disabling the output power converter of the permanent magnet turbogenerator/motor;
analyzing the grid voltage magnitude and frequency for an unacceptable connection;
determining that the maximum allowable reconnection time has not expired;
determining that the DC bus level is below the turn on point of the brake resistor;
applying the brake resistor to control DC bus voltage;
determining that the grid is acceptable for connection; and

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15 enabling the output power converter of the permanent magnet turbogenerator/motor to
16 continue normal operation of the permanent magnet turbogenerator/motor.

1 7. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
2 grid connect mode and said step of determining that the permanent magnet turbogenerator/motor
3 has a fatal fault present and is in the process of shutting down comprises the steps of:

4 detecting no output over-current;

5 detecting a loss of output current control or a loss of DC bus voltage control;

6 determining that less than a fixed number of warning faults has occurred within a fixed
7 period of time;

8 reporting a grid unbalance warning fault;

9 disabling the output power converter of the permanent magnet turbogenerator/motor;

10 analyzing the grid voltage magnitude and frequency for an unacceptable connection;

11 determining that the maximum allowable reconnection time has not expired;

12 determining that the DC bus level is below the turn on point of the brake resistor;

13 determining that the grid is acceptable for connection; and

14 enabling the output power converter of the permanent magnet turbogenerator/motor to

15 continue normal operation of the permanent magnet turbogenerator/motor.

1 8. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
2 grid connect mode and said step of determining that the permanent magnet turbogenerator/motor
3 has a fatal fault present and is in the process of shutting down comprises the steps of:

4 detecting no output over-current;

5 detecting a loss of output current control or a loss of DC bus voltage control;

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6 determining that less than a fixed number of warning faults has occurred within a fixed
7 period of time;
8 reporting a grid unbalance warning fault;
9 disabling the output power converter of the permanent magnet turbogenerator/motor;
10 analyzing the grid voltage magnitude and frequency for an unacceptable connection;
11 determining that the maximum allowable reconnection time has not expired;
12 determining that the DC bus level is not below the turn on point of the brake resistor;
13 applying the brake resistor to control DC bus voltage;
1 determining that the grid is unacceptable for connection;
determining that the maximum allowable reconnection time has expired; and
reporting a grid fatal fault and initiating shutdown of the permanent magnet
turbogenerator/motor.

9. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a grid connect mode and said step of determining that the permanent magnet turbogenerator/motor has a fatal fault present and is in the process of shutting down comprises the steps of:

6 detecting an over-current condition;
determining that less than a fixed number of over-current events have occurred within a
fixed period of time;
7 disabling the output power converter of the permanent magnet turbogenerator/motor;
8 determining that the output current of the permanent magnet turbogenerator/motor is not
9 at a normal level in all phases;
10 determining that the DC bus level is not below the turn on point of the brake resistor;
11 applying the brake resistor to control DC bus voltage;

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12 determining that the output current of the permanent magnet turbogenerator/motor is at a
13 normal level in all phases; and

14 enabling the output power converter of the permanent magnet turbogenerator/motor to
15 continue normal operation of the permanent magnet turbogenerator/motor.

1 10. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
2 grid connect mode and said step of determining that the permanent magnet turbogenerator/motor
3 has a fatal fault present and is in the process of shutting down comprises the steps of:

4 detecting an over-current condition;
5 determining that less than a fixed number of over-current events have occurred within a
6 fixed period of time;

7 disabling the output power converter of the permanent magnet turbogenerator/motor;
8 determining that the output current of the permanent magnet turbogenerator/motor is not
9 at a normal level in all phases;

10 determining that the DC bus level is below the turn on point of the brake resistor;
11 determining that the output current of the permanent magnet turbogenerator/motor is at a
12 normal level in all phases; and

13 enabling the output power converter of the permanent magnet turbogenerator/motor to
14 continue normal operation of the permanent magnet turbogenerator/motor.

1 11. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
2 grid connect mode and said step of determining that the permanent magnet turbogenerator/motor
3 has a fatal fault present and is in the process of shutting down comprises the steps of:

4 detecting an over-current condition;

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5 determining that more than a fixed number of over-current events have occurred within a
6 fixed period of time;

7 determining that more than a fixed number of warning faults has occurred within a fixed
8 period of time;

9 reporting a grid fatal fault and initiating shutdown of the permanent magnet
10 turbogenerator/motor.

1 12. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
2 standalone mode and said step of determining that the permanent magnet turbogenerator/motor
3 has a fatal fault present and is in the process of shutting down comprises the steps of:

detecting an over-current condition;

determining that less than a fixed number of over-current events have occurred within a
fixed period of time;

disabling the output power converter of the permanent magnet turbogenerator/motor;

determining that the output current of the permanent magnet turbogenerator/motor is at a
normal level in all phases; and

enabling the output power converter of the permanent magnet turbogenerator/motor to
continue normal operation of the permanent magnet turbogenerator/motor.

1 13. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
2 standalone mode and said step of determining that the permanent magnet turbogenerator/motor
3 has a fatal fault present and is in the process of shutting down comprises the steps of:

4 detecting an over-current condition;

5 determining that more than a fixed number of over current events have occurred within a
6 fixed period of time;

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7 determining that less than a fixed number of warning faults has occurred within a fixed
8 period of time;
9 reporting a grid unbalance warning fault;
10 disabling the output power converter of the permanent magnet turbogenerator/motor;
11 resetting the output voltage control ready for a soft start; and
12 enabling the output power converter of the permanent magnet turbogenerator/motor to
13 continue normal operation of the permanent magnet turbogenerator/motor.

1 14. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
2 standalone mode and said step of determining that the permanent magnet turbogenerator/motor
3 has a fatal fault present and is in the process of shutting down comprises the steps of:
4 detecting an over-current condition;
5 determining that less than a fixed number of over-current events have occurred within a
6 fixed period of time;
7 disabling the output power converter of the permanent magnet turbogenerator/motor;
8 determining that the output current of the permanent magnet turbogenerator/motor is not
9 at a normal level in all phases;
10 determining that the DC bus level is below the turn on point of the brake resistor;
11 determining that the output current of the permanent magnet turbogenerator/motor is at a
12 normal level in all phases; and
13 enabling the output power converter of the permanent magnet turbogenerator/motor to
14 continue normal operation of the permanent magnet turbogenerator/motor.

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- 1 15. The method of claim 1 wherein the permanent magnet turbogenerator/motor is in a
2 standalone mode and said step of determining that the permanent magnet turbogenerator/motor
3 has a fatal fault present and is in the process of shutting down comprises the steps of:
4 detecting an over-current condition;
5 determining that less than a fixed number of over-current events have occurred within a
6 fixed period of time;
7 disabling the output power converter of the permanent magnet turbogenerator/motor;
8 determining that the output current of the permanent magnet turbogenerator/motor is not
at a normal level in all phases;
 determining that the DC bus level is not below the turn on point of the brake resistor;
 applying the brake resistor to control DC bus voltage;
 determining that the output current of the permanent magnet turbogenerator/motor is at a
normal level in all phases; and
 enabling the output power converter of the permanent magnet turbogenerator/motor to
continue normal operation of the permanent magnet turbogenerator/motor.

16. A method of restarting a permanent magnet turbogenerator/motor, comprising them
steps of:

- 3 determining that the permanent magnet turbogenerator/motor has a fatal fault present and
4 is in the process of shutting down;
5 determining that the permanent magnet turbogenerator/motor has less than a fixed
6 number of restart attempts since the permanent magnet turbogenerator/motor was determined to
7 have a fatal fault;

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8 determining that the permanent magnet turbogenerator/motor is in a recharge state where
9 an internal energy storage device is being recharged as part of the shutdown process;

10 determining that a fixed period of time has elapsed since any previous attempt to restart
11 the permanent magnet turbogenerator/motor;

12 attempt to clear the fault present in the permanent magnet turbogenerator/motor;

13 issue a restart command to the permanent magnet turbogenerator/motor if the fatal fault is
14 successfully cleared; and

15 continue normal operation of the permanent magnet turbogenerator/motor.

17. A method of restarting a permanent magnet turbogenerator/motor, comprising them
steps of:

 determining that the permanent magnet turbogenerator/motor has a fatal fault present and
is in the process of shutting down;

 determining that the permanent magnet turbogenerator/motor has less than a fixed
number of restart attempts since the permanent magnet turbogenerator/motor was determined to
have a fatal fault;

 determining that the permanent magnet turbogenerator/motor is in a cooldown state
where the turbogenerator/motor is being rotated when combustion has ceased to lower the
internal temperature as part of the shutdown process and that the internal temperature is below a
cooldown restart temperature;

 determining that a fixed period of time has elapsed since any previous attempt to restart
the permanent magnet turbogenerator/motor;

 attempt to clear the fault present in the permanent magnet turbogenerator/motor;

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15 issue a restart command to the permanent magnet turbogenerator/motor if the fatal fault is
16 successfully cleared; and

17 continue normal operation of the permanent magnet turbogenerator/motor.

1 18. A method of restarting a permanent magnet turbogenerator/motor, comprising them
2 steps of:

3 determining that the permanent magnet turbogenerator/motor has a fatal fault present and
4 is in the process of shutting down;

5 determining that the permanent magnet turbogenerator/motor has less than a fixed
6 number of restart attempts since the permanent magnet turbogenerator/motor was determined to
7 have a fatal fault;

8 determining that the permanent magnet turbogenerator/motor is in a fault state;

9 determining that a fixed period of time has elapsed since any previous attempt to restart
10 the permanent magnet turbogenerator/motor;

11 attempt to clear the fault present in the permanent magnet turbogenerator/motor;

12 issue a restart command to the permanent magnet turbogenerator/motor if the fatal fault is

13 successfully cleared; and

14 continue normal operation of the permanent magnet turbogenerator/motor.

1 19. A method of restarting a permanent magnet turbogenerator/motor, comprising them
2 steps of:

3 determining that the permanent magnet turbogenerator/motor has a fatal fault present and
4 is in the process of shutting down;

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5 determining that the permanent magnet turbogenerator/motor has less than a fixed
6 number of restart attempts since the permanent magnet turbogenerator/motor was determined to
7 have a fatal fault;

8 determining that the permanent magnet turbogenerator/motor is in a standby state;
9 issue a restart command to the permanent magnet turbogenerator/motor; and
10 continue normal operation of the permanent magnet turbogenerator/motor.

1 20. A method of restarting a permanent magnet turbogenerator/motor, comprising them
2 steps of:

3 determining that the permanent magnet turbogenerator/motor has a fatal fault present and
4 is in the process of shutting down;

5 determining that the permanent magnet turbogenerator/motor has less than a fixed
6 number of restart attempts since the permanent magnet turbogenerator/motor was determined to
7 have a fatal fault;

8 determining that the permanent magnet turbogenerator/motor is in a recharge state where
9 an internal energy storage device is being recharged as part of the shutdown process;

10 determining that a fixed period of time has not elapsed since any previous attempt to
11 restart the permanent magnet turbogenerator/motor;

12 continue shutdown of the permanent magnet turbogenerator/motor.

1 21. A method of restarting a permanent magnet turbogenerator/motor, comprising them
2 steps of:

3 determining that the permanent magnet turbogenerator/motor has a fatal fault present and
4 is in the process of shutting down;

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5 determining that the permanent magnet turbogenerator/motor has less than a fixed
6 number of restart attempts since the permanent magnet turbogenerator/motor was determined to
7 have a fatal fault;

8 determining that the permanent magnet turbogenerator/motor is in a cooldown state
9 where the turbogenerator/motor is being rotated when combustion has ceased to lower the
10 internal temperature as part of the shutdown process and that the internal temperature is below a
11 cooldown restart temperature;

12 determining that a fixed period of time has elapsed since any previous attempt to restart
the permanent magnet turbogenerator/motor;

attempt to clear the fault present in the permanent magnet turbogenerator/motor; and
continue shutdown of the permanent magnet turbogenerator/motor when the fault is not
cleared.

22. A method of restarting a permanent magnet turbogenerator/motor, comprising them
steps of:

determining that the permanent magnet turbogenerator/motor has a fatal fault present and
is in the process of shutting down;

determining that the permanent magnet turbogenerator/motor has less than a fixed
6 number of restart attempts since the permanent magnet turbogenerator/motor was determined to
7 have a fatal fault;

8 determining that the permanent magnet turbogenerator/motor is in a fault state;

9 determining that a fixed period of time has elapsed since any previous attempt to restart
10 the permanent magnet turbogenerator/motor;

11 attempt to clear the fault present in the permanent magnet turbogenerator/motor; and

12 continue shutdown of the permanent magnet turbogenerator/motor when the fault is not
13 cleared.

23. A method of determining the fault condition of a permanent magnet turbogenerator/motor in a grid connect mode, comprising the steps of:

- detecting an over-current condition;
- determining that less than a fixed number of over-current events have occurred within a fixed period of time;
- disabling the output power converter of the permanent magnet turbogenerator/motor;
- determining that the output current of the permanent magnet turbogenerator/motor is at a

- normal level in all phases; and
- enabling the output power converter of the permanent magnet turbogenerator/motor to continue normal operation of the permanent magnet turbogenerator/motor.

24. A method of determining the fault condition of a permanent magnet turbogenerator/motor in a grid connect mode, comprising the steps of:

- detecting no output over-current;
- detecting a loss of output current control or a loss of DC bus voltage control;
- determining that more than a fixed number of warning faults has occurred within a fixed

reporting a grid fatal fault and initiating shutdown of the permanent magnet turbogenerator/motor.

1 25. A method of determining the fault condition of a permanent magnet
2 turbogenerator/motor in a grid connect mode, comprising the steps of:
3 detecting no output over-current;

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4 detecting a loss of output current control or a loss of DC bus voltage control;
5 determining that less than a fixed number of warning faults has occurred within a fixed
6 period of time;
7 reporting a grid unbalance warning fault;
8 disabling the output power converter of the permanent magnet turbogenerator/motor;
9 analyzing the grid voltage magnitude and frequency for an acceptable connection; and
10 enabling the output power converter of the permanent magnet turbogenerator/motor to
11 continue normal operation of the permanent magnet turbogenerator/motor.

26. A method of determining the fault condition of a permanent magnet

turbogenerator/motor in a grid connect mode, comprising the steps of:

detecting no output over-current;
detecting a loss of output current control or a loss of DC bus voltage control;
determining that less than a fixed number of warning faults has occurred within a fixed
period of time;
reporting a grid unbalance warning fault;
disabling the output power converter of the permanent magnet turbogenerator/motor;
analyzing the grid voltage magnitude and frequency for an unacceptable connection;
determining that the maximum allowable reconnection time has expired; and
reporting a grid fatal fault and initiating shutdown of the permanent magnet
turbogenerator/motor.

27. A method of determining the fault condition of a permanent magnet

2 turbogenerator/motor in a grid connect mode, comprising the steps of:

3 detecting no output over-current;

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4 detecting a loss of output current control or a loss of DC bus voltage control;
5 determining that less than a fixed number of warning faults has occurred within a fixed
6 period of time;
7 reporting a grid unbalance warning fault;
8 disabling the output power converter of the permanent magnet turbogenerator/motor;
9 analyzing the grid voltage magnitude and frequency for an unacceptable connection;
10 determining that the maximum allowable reconnection time has not expired;
11 determining that the DC bus level is not below the turn on point of the brake resistor;
12 applying the brake resistor to control DC bus voltage;
 determine that the grid is acceptable for connection; and
 enabling the output power converter of the permanent magnet turbogenerator/motor to
continue normal operation of the permanent magnet turbogenerator/motor.

28. A method of determining the fault condition of a permanent magnet
turbogenerator/motor in a grid connect mode, comprising the steps of:
 detecting no output over-current;
 detecting a loss of output current control or a loss of DC bus voltage control;
 determining that less than a fixed number of warning faults has occurred within a fixed
6 period of time;
7 reporting a grid unbalance warning fault;
8 disabling the output power converter of the permanent magnet turbogenerator/motor;
9 analyzing the grid voltage magnitude and frequency for an unacceptable connection;
10 determining that the maximum allowable reconnection time has not expired;
11 determining that the DC bus level is below the turn on point of the brake resistor;

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12 determine that the grid is acceptable for connection; and
13 enabling the output power converter of the permanent magnet turbogenerator/motor to
14 continue normal operation of the permanent magnet turbogenerator/motor.

1 29. A method of determining the fault condition of a permanent magnet
2 turbogenerator/motor in a grid connect mode, comprising the steps of:
3 detecting no output over-current;
4 detecting a loss of output current control or a loss of DC bus voltage control;
5 determining that less than a fixed number of warning faults has occurred within a fixed
6 period of time;
7 reporting a grid unbalance warning fault;
8 disabling the output power converter of the permanent magnet turbogenerator/motor;
9 analyzing the grid voltage magnitude and frequency for an unacceptable connection;
10 determining that the maximum allowable reconnection time has not expired;
11 determining that the DC bus level is not below the turn on point of the brake resistor;
12 applying the brake resistor to control DC bus voltage;
13 determine that the grid is unacceptable for connection;
14 determining that the maximum allowable reconnection time has expired; and
15 reporting a grid fatal fault and initiating shutdown of the permanent magnet
16 turbogenerator/motor.

1 30. A method of determining the fault condition of a permanent magnet
2 turbogenerator/motor in a grid connect mode, comprising the steps of:
3 detecting an over-current condition;

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4 determining that less than a fixed number of over-current events have occurred within a
5 fixed period of time;

6 disabling the output power converter of the permanent magnet turbogenerator/motor;

7 determining that the output current of the permanent magnet turbogenerator/motor is not
8 at a normal level in all phases;

9 determining that the DC bus level is not below the turn on point of the brake resistor;

10 applying the brake resistor to control DC bus voltage;

11 determining that the output current of the permanent magnet turbogenerator/motor is at a
12 normal level in all phases; and

enabling the output power converter of the permanent magnet turbogenerator/motor to
continue normal operation of the permanent magnet turbogenerator/motor.

31. A method of determining the fault condition of a permanent magnet
turbogenerator/motor in a grid connect mode, comprising the steps of:

detecting an over-current condition;

determining that less than a fixed number of over-current events have occurred within a
fixed period of time;

disabling the output power converter of the permanent magnet turbogenerator/motor;

determining that the output current of the permanent magnet turbogenerator/motor is not
at a normal level in all phases;

determining that the DC bus level is below the turn on point of the brake resistor;

determining that the output current of the permanent magnet turbogenerator/motor is at a
normal level in all phases; and

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enabling the output power converter of the permanent magnet turbogenerator/motor to continue normal operation of the permanent magnet turbogenerator/motor.

32. A method of determining the fault condition of a permanent magnet turbogenerator/motor in a grid connect mode, comprising the steps of:

detecting an over-current condition;

determining that more than a fixed number of over-current events have occurred within a period of time;

determining that more than a fixed number of warning faults has occurred within a fixed period of time;

reporting a grid fatal fault and initiating shutdown of the permanent magnet turbogenerator/motor.

33. A method of determining the fault condition of a permanent magnet turbogenerator/motor in a standalone mode, comprising the steps of:

detecting an over-current condition

determining that less than a fixed number of over-current events have occurred within a fixed period of time;

disabling the output power converter of the permanent magnet turbogenerator/motor; determining that the output current of the permanent magnet turbogenerator/motor is

normal level in all phases; and

continue normal operation of the permanent magnet turbogenerator/motor.

turbogenerator/motor in a standalone mode, comprising the steps of:

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3 detecting an over-current condition;

4 determining that more than a fixed number of over current events have occurred within a

5 fixed period of time;

6 determining that less than a fixed number of warning faults has occurred within a fixed

7 period of time;

8 reporting a grid unbalance warning fault;

9 disabling the output power converter of the permanent magnet turbogenerator/motor;

10 resetting the output voltage control ready for a soft start; and

 enabling the output power converter of the permanent magnet turbogenerator/motor to
continue normal operation of the permanent magnet turbogenerator/motor.

35. A method of determining the fault condition of a permanent magnet
turbogenerator/motor in a standalone mode, comprising the steps of:

 detecting an over-current condition;

 determining that less than a fixed number of over-current events have occurred within a
fixed period of time;

 disabling the output power converter of the permanent magnet turbogenerator/motor;

 determining that the output current of the permanent magnet turbogenerator/motor is not
at a normal level in all phases;

 determining that the DC bus level is below the turn on point of the brake resistor;

 determining that the output current of the permanent magnet turbogenerator/motor is at a
normal level in all phases; and

 enabling the output power converter of the permanent magnet turbogenerator/motor to
continue normal operation of the permanent magnet turbogenerator/motor.

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- 1 36. A method of determining the fault condition of a permanent magnet
2 turbogenerator/motor in a standalone mode, comprising the steps of:
3 detecting an over-current condition;
4 determining that less than a fixed number of over-current events have occurred within a
5 fixed period of time;
6 disabling the output power converter of the permanent magnet turbogenerator/motor;
7 determining that the output current of the permanent magnet turbogenerator/motor is not
8 at a normal level in all phases;
9 determining that the DC bus level is not below the turn-on point of the brake resistor;
C applying the brake resistor to control DC bus voltage;
 determining that the output current of the permanent magnet turbogenerator/motor is at a
normal level in all phases; and
 enabling the output power converter of the permanent magnet turbogenerator/motor to
continue normal operation of the permanent magnet turbogenerator/motor.
37. A permanent magnet turbogenerator/motor restarting system, comprising:
 means for determining that the permanent magnet turbogenerator/motor has a fatal fault
present and is in the process of shutting down;
 means for determining that the permanent magnet turbogenerator/motor has more than a
fixed number of restart attempts since the permanent magnet turbogenerator/motor was
determined to have a fatal fault; and
 means to continue shutdown of the permanent magnet turbogenerator/motor.
- 1 38. A permanent magnet turbogenerator/motor restarting system, comprising:

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2 means for determining that the permanent magnet turbogenerator/motor has a fatal fault
3 present and is in the process of shutting down;

4 means for determining that the permanent magnet turbogenerator/motor has less than a
5 fixed number of restart attempts since the permanent magnet turbogenerator/motor was
6 determined to have a fatal fault;

7 determining that the permanent magnet turbogenerator/motor is in a recharge state where
8 an internal energy storage device is being recharged as part of the shutdown process;

9 means for determining that a fixed period of time has elapsed since any previous attempt
10 to restart the permanent magnet turbogenerator/motor;

means to attempt to clear the fault present in the permanent magnet turbogenerator/motor;

means to issue a restart command to the permanent magnet turbogenerator/motor if the
fatal fault is successfully cleared; and

means to continue normal operation of the permanent magnet turbogenerator/motor.

39. A permanent magnet turbogenerator/motor restarting system, comprising:

means for determining that the permanent magnet turbogenerator/motor has a fatal fault
present and is in the process of shutting down;

means for determining that the permanent magnet turbogenerator/motor has less than a
fixed number of restart attempts since the permanent magnet turbogenerator/motor was
6 determined to have a fatal fault;

7 means for determining that the permanent magnet turbogenerator/motor is in a cooldown
8 state where the turbogenerator/motor is being rotated when combustion has ceased to lower the
9 internal temperature as part of the shutdown process and that the internal temperature is below a
10 cooldown restart temperature;

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11 means for determining that a fixed period of time has elapsed since any previous attempt
12 to restart the permanent magnet turbogenerator/motor;
13 means to attempt to clear the fault present in the permanent magnet turbogenerator/motor;
14 means to issue a restart command to the permanent magnet turbogenerator/motor if the
15 fatal fault is successfully cleared; and
16 means to continue normal operation of the permanent magnet turbogenerator/motor.

1 40. A permanent magnet turbogenerator/motor restarting system, comprising:

2 means for determining that the permanent magnet turbogenerator/motor has a fatal fault
present and is in the process of shutting down;
means for determining that the permanent magnet turbogenerator/motor has less than a
fixed number of restart attempts since the permanent magnet turbogenerator/motor was
determined to have a fatal fault;

means for determining that the permanent magnet turbogenerator/motor is in a fault state;

means for determining that a fixed period of time has elapsed since any previous attempt
to restart the permanent magnet turbogenerator/motor;

means to attempt to clear the fault present in the permanent magnet turbogenerator/motor;

means to issue a restart command to the permanent magnet turbogenerator/motor if the

12 fatal fault is successfully cleared; and

13 means to continue normal operation of the permanent magnet turbogenerator/motor.

1 41. A permanent magnet turbogenerator/motor restarting system, comprising:

2 means for determining that the permanent magnet turbogenerator/motor has a fatal fault

3 present and is in the process of shutting down;

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4 means for determining that the permanent magnet turbogenerator/motor has less than a
5 fixed number of restart attempts since the permanent magnet turbogenerator/motor was
6 determined to have a fatal fault;

7 means for determining that the permanent magnet turbogenerator/motor is in a standby
8 state;

9 means to issue a restart command to the permanent magnet turbogenerator/motor; and
10 means to continue normal operation of the permanent magnet turbogenerator/motor.

1 42. A permanent magnet turbogenerator/motor restarting system, comprising:

2 means for determining that the permanent magnet turbogenerator/motor has a fatal fault
3 present and is in the process of shutting down;

means for determining that the permanent magnet turbogenerator/motor has less than a
fixed number of restart attempts since the permanent magnet turbogenerator/motor was
determined to have a fatal fault;

determining that the permanent magnet turbogenerator/motor is in a recharge state where
an internal energy storage device is being recharged as part of the shutdown process;

means for determining that a fixed period of time has not elapsed since any previous
attempt to restart the permanent magnet turbogenerator/motor;

11 means to continue shutdown of the permanent magnet turbogenerator/motor.

1 43. A permanent magnet turbogenerator/motor restarting system, comprising:

2 means for determining that the permanent magnet turbogenerator/motor has a fatal fault
3 present and is in the process of shutting down;

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4 means for determining that the permanent magnet turbogenerator/motor has less than a
5 fixed number of restart attempts since the permanent magnet turbogenerator/motor was
6 determined to have a fatal fault;

7 means for determining that the permanent magnet turbogenerator/motor is in a cooldown
8 state where the turbogenerator/motor is being rotated when combustion has ceased to lower the
9 internal temperature as part of the shutdown process and that the internal temperature is below a
10 cooldown restart temperature;

11 means for determining that a fixed period of time has elapsed since any previous attempt
12 to restart the permanent magnet turbogenerator/motor;

means to attempt to clear the fault present in the permanent magnet turbogenerator/motor;
and

means to continue shutdown of the permanent magnet turbogenerator/motor when the
fault is not cleared.

44. A permanent magnet turbogenerator/motor restarting system, comprising:

means for determining that the permanent magnet turbogenerator/motor has a fatal fault
present and is in the process of shutting down;

means for determining that the permanent magnet turbogenerator/motor has less than a
5 fixed number of restart attempts since the permanent magnet turbogenerator/motor was
6 determined to have a fatal fault;

7 means for determining that the permanent magnet turbogenerator/motor is in a fault state;

8 means for determining that a fixed period of time has elapsed since any previous attempt
9 to restart the permanent magnet turbogenerator/motor;

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10 means to attempt to clear the fault present in the permanent magnet turbogenerator/motor;

11 and

12 means to continue shutdown of the permanent magnet turbogenerator/motor when the
13 fault is not cleared.

1 45. The permanent magnet turbogenerator/motor restarting system of claim 44 wherein
2 said means for determining that the permanent magnet turbogenerator/motor has a fatal fault
3 present and is in the process of shutting down, comprises:

4 means for detecting no output over-current;

5 means for detecting a loss of output current control or a loss of DC bus voltage control;

means for determining that less than a fixed number of warning faults has occurred
within a fixed period of time;

means for reporting a grid unbalance warning fault;

means for disabling the output power converter of the permanent magnet
turbogenerator/motor;

means for analyzing the grid voltage magnitude and frequency for an unacceptable
connection;

means for determining that the maximum allowable reconnection time has not expired;

14 means for determining that the DC bus level is not below the turn on point of the brake
15 resistor;

16 means for applying the brake resistor to control DC bus voltage;

17 means for determining that the grid is acceptable for connection; and

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- 18 means for enabling the output power converter of the permanent magnet
- 19 turbogenerator/motor to continue normal operation of the permanent magnet
- 20 turbogenerator/motor.

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